CLAIMS

What is claimed is:

1. A method for removing effects of gain and phase mismatch in amplification branches of a linear amplification using nonlinear components (LINC) system, comprising:

receiving an input signal;

calculating a relative phase and gain difference in the amplification branches;

generating phasing components; and

controlling separation of the input signal into a plurality of branch signals of different but constant envelopes by appropriately applying the phasing components to the amplification branches, such that when the branch signals are recombined, the combined signal substantially replicates the input signal.

2. The method of claim 1, wherein said calculating a relative phase and gain difference includes

modulating and sending calibration signals and demodulating the training signals using a receiver.

3. The method of claim 2, wherein said modulating and sending calibration signals includes

calculating reference vectors of the branch signals, where each reference vector accounts for total gain and phase shift of a corresponding branch signal when no phase shift is applied to a phase modulator in the corresponding branch.

4. The method of claim 1, wherein said generating phasing components includes

configuring an elliptic curve based on the calculated reference vectors.

5. The method of claim 4, wherein said generating phasing components includes

obtaining a point on the elliptic curve corresponding to a vector having same magnitude as the input signal.

6. The method of claim 5, wherein said obtaining a point on the elliptic curve includes

searching for an appropriate value for φ from $|S(t)| = |(A + B) \cdot cos\varphi + j(B - A) \cdot sin\varphi|$, where $|S(t)|$ is magnitude of the input signal, and A and B are the reference vectors.

7. The method of claim 5, wherein said obtaining a point on the elliptic curve includes

generating a lookup table having a corresponding relationship between magnitude of the input signal and the point on the elliptic curve.

8. The method of claim 7, wherein said obtaining a point on the elliptic curve includes

searching the lookup table for the point on the elliptic curve that corresponds to the desired magnitude of the input signal.

9. The method of claim 4, wherein said generating phasing components includes

calculating a phase skew (Δ), which is a phase difference between a vector ending at a point on the elliptic curve and a sum vector that is a sum of the reference vectors.

10. The method of claim 9, wherein said generating phasing components includes

generating a look-up table having a corresponding relationship between a phase skew (Δ) and a point on the elliptic curve.

11. The method of claim 1, wherein said controlling separation of the input signal into a plurality of branch signals includes

applying appropriate phasing components $\theta(t)-\Delta-\varphi$ and $\theta(t)-\Delta+\varphi$ to phase modulators in amplification branches to generate at least following branch signals $S_1(t) = A \cdot e^{j(\theta(t)-\Delta-\varphi)}$ and $S_2(t) = B \cdot e^{j(\theta(t)-\Delta+\varphi)}$, where $S_1(t)$ is a first branch signal and $S_2(t)$ is a second branch signal, A and B are reference vectors, $\theta(t)$ is phase of the input signal, Δ is the phase skew, and φ corresponds to the point on the elliptic curve that relates a vector having the same magnitude as the input signal.

12. The method of claim 11, wherein said controlling separation of the input signal into a plurality of branch signals includes

approximating $S(t) = |S(t)|e^{j\theta}$ by $V_{min} \cdot e^{j\theta}$ with a corresponding φ achieving the minimum when $|S(t)| < V_{min} = \min_{0\le\varphi\le\pi/2}\{|(A + B)\cdot\cos\varphi + j(B - A)\cdot\sin\varphi|\}$, where V_{min} defines a dead circle.

13. The method of claim 12, where said controlling separation of the input signal into a plurality of branch signals includes

providing at least three branch signals to avoid the dead circle.

14. The method of claim 13, where said providing at least three branch signals includes

providing a third branch signal with a vector whose magnitude is larger than the radius of the dead circle.

15. The method of claim 14, where said providing a third branch signal moves the dead circle away from a null position.

16. A method for removing effects of gain and phase mismatch in amplification branches of a linear amplification using nonlinear components (LINC) system, comprising:

determining amplitudes and phases of branch signals, A and B, with no phase shifts applied;

first computing φ at a point on an elliptic curve that corresponds to $|S(t)|$, given $S(t) = |S(t)|e^{j\theta(t)}$;

second computing phase skew between Z_1 and Z_3, where $Z_1 = (B + A)\cos\varphi$, $Z_2 = j(B - A)\sin\varphi$, and $Z_3 = Z_1 + Z_2$; and

generating $S_1(t) = A \cdot e^{j(\theta(t) - \Delta - \varphi)}$ and $S_2(t) = B \cdot e^{j(\theta(t) - \Delta + \varphi)}$, given $S(t) = |S(t)|e^{j\theta(t)}$.

17. The method of claim 16, further comprising:

generating a look-up table for φ as a function of $|S(t)|$, where $|S(t)| = |(A + B) \cdot \cos\varphi + j(B - A) \cdot \sin\varphi|$.

18. The method of claim 16, wherein said determining amplitudes and phase difference of reference branch signals, *A* and *B*, includes

generating signals $S_1(t) = A$ and $S_2(t) = Be^{jx}$ by applying appropriate phase to phase modulators so that the received signal R_1 is equal to $G(S_1(t) + S_2(t)) = G(A + Be^{jx})$, where *G* is a complex constant, which may be removed or scaled to an appropriate value corresponding to transmission power and receiver gain.

19. The method of claim 16, wherein said determining amplitudes and phase difference of reference branch signals, *A* and *B*, includes

generating signals $S_1(t) = A$ and $S_2(t) = -Be^{jx}$ by applying appropriate phase to phase modulators so that the received signal R_2 is equal to $G(S_1(t) + S_2(t)) = G(A - Be^{jx})$, where *G* is a complex constant, which may be removed or scaled to an appropriate value corresponding to transmission power and receiver gain.

20. A linear amplification using nonlinear components (LINC) system, comprising:

a phasing component generator configured to receive an input signal, said phasing component generator operating to control separation of the input signal into a plurality of branch signals by generating phasing components after calculating a relative phase and gain difference in amplification branches and by applying the phasing components as phase shifts to the corresponding amplification branches;

a plurality of phase modulators, each branch including one phase modulator to phase modulate the branch signal with the corresponding phasing component;

a plurality of power amplifiers, each branch including at least one non-linear power amplifier to amplify the phase modulated branch signal; and

a combiner to combine the amplified branch signal such that when the branch signals from the amplification branches are recombined, the combined signal substantially replicates the input signal.

21. The system of claim 20, wherein said phasing component generator includes

a reference vector calculator to compute reference vectors for the branch signals.

22. The system of claim 21, wherein said phasing component generator includes

an elliptic curve configuration element to configure an elliptic curve based on the calculated reference vectors.

23. The system of claim 22, wherein said phasing component generator includes

a lookup table for the elliptic curve configuration element to find a point on the elliptic curve that corresponds to the desired magnitude of the input signal.

24. The system of claim 23, wherein said phasing component generator includes

a lookup table having a corresponding relationship between a phase Skew (Δ) and the point on the elliptic curve.